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The present invention relates to food and feed supplements comprising vitamins. The invention also comprise use of the supplement in food and feed

It has been observed that animals exposed to severe stress or when high performance is demanded, suffer from fatigue, diarrhoea, resistance to feed intake, anaemia etc when they only are fed standard feeds. In such cases it is obviously a need for additives or supplements to the feed. However, it is usually difficult to define what may be the cause for the observed problems, and thus which additive to use. There are known numerous additives and feed supplements, but none have proved to solve all the above problems. Some additives are primarily intended for increased growth of the animal while others claim to improve its health. Vitamin deficiencies might be part of the problem, but then one should understand why this occure even when the feed is expected to contain sufficient amounts of vitamins.

A special problem has been observed on racing horses when they switch from grazing on pastures to intensive feeding, for instance twice a day. It is quite common that said change in feeding procedure results in development of gastric ulser.

It is generally known that addition of monocarboxylic acids to the conventional feed can give increased growth and reduced diarrhoea frequency. From EP 03176688 it is known that promoted growth of piglets can be achieved by applying conventional fodder containing 5-25% of a dry mixture containing 3-5 parts of calcium formate. However, calcium formate has a low water solubility and can only be used in limited amounts to avoid too high content of calcium in the feed. The concentration of formate in the additive is rather low and the effect is only of the same order of magnitude as when formic acid is added to the feed.

It is further known from DE 19958620 a food or food supplements for domestic or working animals applied for preventing conditions associated with vitamin deficiencies and also containing mussel meat or extracts. According to this patent said supplement should contain a number of components like soya oil, carbohydrates, minerals and various vitamins. However, the vitamins are not specified and it is difficult to decide what special problems this supplement should solve. From WO 96/35337 it is further known animal feed additives and feedstuff containing 0.2-2.5 weight % of additives comprising di-compounds of formic salts. The additive comprises 20-99 weight% potassium diformate, 0-50 weight% sodium di/tetra-formate, 0-25 weight% calcium formate, 0-4 weight% desiccants and 0-5 weight% water. This additive is stated to promote growth and improve feed conversion rate, especially during the prestarter period. The influence on diarrhoea frequency is also stated to be positive.

The main object of the present invention was to arrive at a new food and feed supplement that would improve health and performance, especially during stress conditions and when high performance where demanded, i.e during training and competitions conditions.

Another object was to arrive at supplements that could be part of the nutrient intake of the consumer and possessing high concentrations of the active ingredients and still be free flowing dry powder and stable during storage and handling.

It was also an object that the supplement should be water soluble, as it should be possible to add the supplement to drinking water as well as to solid powdered feed or moist feed.

A further object was to be able to supply the consumer with the supplement in predetermined dosages and still be within the spesifications considered necessary for obtaining the desired effect and the supplement should have a desired taste for the consumer for eating or drinking the supplement without any refusal therefore.

From a health point of view it seemed interesting from the literature teachings to supply the nutrient consumer with supplements containing monocarboxylic acids. The inventor therefore decided to start some experiments comprising addition of monocarboxylic acid to the feed. Different pigeon fanciers in Norway and Denmark performed the experiments, which include all together twenty test groups. These experiments gave positive results with regard to growth and diarrhoea frequency and it all seemed promising. However, when the tested animals (pigeons) were exposed to prolonged extreme conditions like training periods and competitions like pigeon racing it was again observed fatigue, anaemia and resistance to feed intake for some of the test groups. Thus there seem to be some side-effects from adding only carboxylic acids/salts to the feed. Fatigue can be explained by deficiencies of numerous components such as vitamin C, vitamin B-complexes, minerals like magnesium, zinc, essential fatty acids etc. The relevant literatures give no clear guidance for solving the above-observed problems. Just adding a mixture of various vitamins and minerals will be only speculative as long as the cause of the problem is not clear. Deficiency of vitamin B_9 (i.e. folic acid) could be assumed from literature definitions of the described deficiency. But similar definitions are also given for deficiency of vitamin B12. (e.g. reference Animal Nutrition, P.McDonald et al. Fifth Edition 1995, pp 80-93). However, it is also known an interaction between B_{12} and B_9 as it seems necessary that B_{12} is present in order for absorption of B_9, so the question will then be what vitamin should be supplemented. Some of the test groups did however perform well within the observed symptoms. During interviews of the different fanciers responsible for the test groups, the inventor got the impression that in the cases of the well performing groups the responsible fanciers had been more conscious of adding vitamin mixtures to the pigeon feed than the fanciers of the poor performing groups.

Regarding the above problem with development of gastric ulser, it was assumed that change in feeding procedure would result in inbalance in the stomach acid (HCl) of the animal and consequently results in development of gastric ulser. Based on this hypothesis, it was found advantageous that the supplement, when dissolved in water, had a range of pH corresponding to 2.0-6.0 due based on its buffer capacity. It was further found that the selected B-vitamins were stable for

a prolonged time at said pH range provided that the supplement was not exposed to light. It was also considered advantageous that the supplement may include a buffer component, i.e. the organic acid and it's salt in combination.

It was desired to retain the advantages and positive effects of the monocarboxylic acids. The problem was to overcome the observed long-term negative effects. The inventor then decided to continue his search for a new supplement working according to a hypothesis assuming that the metabolisme of the carboxylic acids some how consumed essential vitamins. In order to try to compensate for said possible lack of vitamins, the role of vitamins in feed for various animals were studied more thoroughly. Thus, with fur animals it has been observed anaemia when organic acids have been added to the feed without additional support of folic acid (vitamin B_9).

Further it has also been reported in the literature that other B-vitamins may influence the production of blood cells, although the exact mechanisms are not clearly understood. Still, it was considered that vitamins B_6 and B_{12} should be good canditates together with vitamin B_9. Accordingly, the inventor decided to add said three B-vitamins to the mixture of monocarboxylic acids, comprising formic acid and its ammonium salt in order to investigate if said addition of vitamins could compensate for the previously observed side-effects related to monocarboxylic acids. Iron was also added to the new feed mixture because reduced haemoglobin levels in the blood had been reported in the literature as a sign of iron deficiency. Said organic acids were chosen because of the reported positive effects of monocarboxylic acids.

However, it was found that also other carboxylic acid had advantageous properties in supplements for the present purpose. The above stated mixture was dissolved in water and mixed with the ordinary water intake for the pigeons. When the supplement was dosed at about 1 gram/litre, the pigeons were reluctant to drink the water. The dosage was then reduced to 0.5gram supplement/litre, at which no reluctancy to drinking was observed. At this dosage the vitamin supplement still was considerably above recommended dosage for vitamin supplement for racing pigeons.

Having been given this supplement for an extended period the pigeons proved to endure stress conditions without problem and performed excellently during racing competitions. Based on the positive results, further similar experiments were started in order to confirm the results and find the correct balance between the components by expanding the experiments to other species than racing pigeons. In view of the results from these experiments it was decided to also add other B-vitamins. It was also considered advantageous to add an antioxidant, preferably vitamin E. An iron component, preferably iron fumarate, should also still be included in the supplement as iron is essential in the production of blood cells. In order to secure a free flowing product a desiccant could be added to the supplement to be further tested, the most preferred desiccant was found to be MgO.

The scope and special features of the invention are as defined by the attached claims.

The main feature of the supplement according to the invention is that it comprise at least one carboxylic and/or its salt as the basic ingredient and the vitamins B_6, B_9 and B_{12} in total amounts of 10-50mg/gram dry weight of the supplement, 5-25mg Fe/gram dry weight of supplement, 0-1 weight% desiccant and 0-1 weight% of an antioxidant.

The amount of vitamins B_6, B_9 and B_{12} should at least correspond to that which can be consumed during metabolism of the COOH-group of the carboxylic acids.

The supplement should preferably contain 0.5-3.5 weight% iron fumarate.

A special feature of the supplement according to the invention is that the prefered amounts of vitamins B_6, B_9 and B_{12} are in the range 10-20mg/gram dry weight of supplement, 10-20mg/gram dry weight of supplement and 60-250µg/gram dry weight of supplement, respectively.

The new supplement should preferably contain vitamin E as antioxidant and MgO as desiccant.

A further feature of the supplement according to the invention comprises that the amount of salts of the carboxylic acids present result in a pH of 2.0-6.0 when the supplement is dissolved in water (i.e adjusted to the wanted pH with the acid/salt buffer property)

The most prefered carboxylic acids and their salts were found to be C_{1-6} carboxylic acids.

The invention also comprises use of the new supplement in animal feed for improving the performance of the animals, in amounts of 0.5-15 grams dry supplement/kg dry feed.

A special use of the supplement is its mixture with the standard feed for horses in amounts of 5-25grams dry supplement/100kg horse weight.

The invention is further explained in connection with the following examples.

Example 1

This experiment was performed on racing pigeons belonging to the company Pigeon Vitality as in Porsgrunn Norway. The pigeons were given 0.5 grams/litre water of carboxylic acids in the drinking water having a pH of 4, daily from the autumn 2001 and through the racing season 2002 ending in July. The first races that spring, the pigeons performed below expectation. They returned home several minutes too late for top prizes. Performance became even worse as the racing season went on, and after the first races (two-three weeks) the pigeons lost their form Three weeks later they showed all signs of anaemia. The races were stopped for the test loft in June 2002 after only six races.

Pigeons from the same loft, same location, on the same feeding system, same training, same racing system, same management were part of the new experiment where supplement (same carboxylic acids) at same dosages in the drinking water were upgraded by addition of vitamins B_6, B_9 and B_{12} and 6 mg iron/kilo supplement. The racing season turned out to be the best ever for Pigeon Vitality as,

with extraordinary good results from start until the last competition six weeks later. The performances are shown in table 1, comparing results for the two seasons.

Table 1

Race no.	Distance in km (2002/2003)	2002. score 1 pigeon	2003, score 1 pigeon
1	150/100	68	100
2	200/200	43	100
3	200/250	0	94
4	350/300	29	100
5	400/400	0	100
6	200/100	17	85
7	Not attending/550	Not attending	100

The score is calculated such that the score can be compared even if the number of attending pigeons in the race may vary. The score S is calculated as $S=100-((P-1)*300)/N$, where N is the total number of attending pigeons and P is the prize of the pigeon. First prize will always give 100 in score, while a score of 0 will be given to the 66.7% of the pigeons that returned as the latest ones. The table gives the score of the first pigeons for the test loft of Pigeon Vitality as.

Example 2

These examples were performed on racing horses (trotters) after the success of the new supplement applied on racing pigeons. Horses were given either 10grams supplement/100kg horse daily, or daily 15gram supplement/kg feed. The experiments started in the autumn of 2003, and one objective was to find the proper level of dosage, and to take notes of the development of the horses vitality together with blood samples. The blood samples were analyzed with respect to concentration of blood cells. The main objective of these experiments was to confirm that the concentration level of the blood cells, especially the red blood cells, was not reduced by intake of the new supplement. Observations of the vitality of the horses confirmed

that they were in excellent shape during and after races. The blood analyses confirmed that the new supplement had similar effect on horses as on pigeons.

The possible effect on the above mentioned gastric ulser problem experienced on horses was also investigated. A horse having developed gastric ulcer was fed twice a day. Contrary to the normal procedure he now got 45grams (dry weight) of the new supplement mixed with the normal feed daily for 14 days. The horse weighed 450kg and accordingly the addition of supplement corresponds to 10 grams dry weight of the supplement/100kg horse weight. At the end of this new feeding period gastroscopic examination revealed that the gastric ulcer had been healed. The horse was therefore allowed to start in a race in which he performed extremely well. In view of further investigations, it was found that the above effect could be achieved by addition of 5-25grams supplement/100kg horse weight to the standard feed.

Example 3.

These experiments were perfonned on racing dogs (racing dog team) after the above experiments with the pigeons. The experiments started in the autumn of 2003 and the objectives were to find the proper level of dosage, and to take notes of the dog's vitality and fur, together with blood samples. The blood samples were taken from two test groups, one without any of the new supplement, while the other test group were given 2,5grams supplement per kilo feed per day. Blood samples were analysed with respect to the concentration of blood cells before start, after 2 months and after the end of the racing season. The results of these experiments confirmed that the new supplement gave similar results for dogs as for pigeons and horses. There were no signs of anaemia on the dogs and the level of blood cells remained about the same during the test period. Observation of the vitality of the dogs showed that they were in good shape throughout the test period. Even the fur of the dogs proved to be excellent.

From the above examples it can be seen that the amount of added vitamins B_6, B_{12} and in particular the B_9 vitamin in the new supplement should at least correspond to the amount of COOH-groups that can be metabolised by the consumer. Based on the results from all the experiments and information found in the literature, the inventor

arrived at the following table 2 for recommeded vitamin content in the supplement according to the invention.

Table 2.

Group of species	B_6 (mg/kg feed)	B_{12} (µg/kg feed)	B_9 (mg/kg feed)	Fe (mg/kg feed)
Poultry	1-7.4	15-40	0.5-4	80-90
Pigeons	1-5	20	1	-
Pigs	3-6.2	20-60	0.6-5	57-62
Cattle	4-6.2	30-50	-	30-40
Sheep	-	15	2	30
Fish	8-12.3	30-50	4-10	-
Horses	3-3.7	20	10	40-100
Rabbits	1-1.2	5	0.2-0.5	-
Maximum	12	60	10	100
Supplement to feed (2.5gram /kg feed)	41	500	45	32
Supplement to water (0.5gram /litre)	10	120	11	8

The recommendations for addition of vitamins to various species are given as vitamin supplement per kg feed and in accordance with this the vitamin amounts are shown using the new supplement per kg feed (the 2 last rows in table 2). The additions of supplement are given for two dosages, 2.5grams/kg feed, and 0.5grams per liter for pigeons, respectively (the dosage from litre to kg feed is calculated from the knowledge that a pigeon on the average drink 50ml water and eat 40 grams feed per day). The recommended amounts of the new supplement will vary depending on species and their age. Generally 2.5gram supplement per kg feed is

considered optimal, but amounts of 0.5- 15grams dry supplement/kg feed were found to give the desired results. The upper range will in most cases represent an over-dosage and this will be on purpose for racing conditions as they generally require extra feed and vitamin supply. All the B-vitamins are water soluble and any excess will be excreted. Another reason for securing that one is on the safe side is that the level of metabolic oxidation of carboxylic acids vary from species to species and still is not fully understood scientifically.

The recommended supply of iron will depend on the activity of the species. As iron is widely distributed in the feed in question, and because the efficiency of absorption of iron is increased during periods of need and therefore the above formulations are relatively low compared to that generally recommended. During these experiments iron fumarate has been used as iron source and it contain 32% iron. This has been corrected for in table 2. The recommendable amounts of iron in the supplement was found to be in the range of 5-25mg Fe/gram dry supplement, preferably in the range 10-15mg Fe.

The carboxylic acid/salt mixture used during the experiments comprises formic acid, ammonium formate and lactic acid. It was found that the vitamins should preferably be added as vitamin B-complexes since all B-vitamins (i.e. all B-vitamins, including B_6, B_9 and B_{12}) are incorporated in various enzyme systems, and because their interactions and metabolic routes are not clearly understood. However, as shown above, it is essential that vitamins B_6, B_9 and B_{12} are present in the recommended amounts. Accordingly, the amount of vitamin B_6 in the new supplement should be in the range 10-20 mg/gram dry supplement, B_9 in the range 10-20mg/gram dry supplement and B_{12} in the range 60-250µg/gram dry supplement. The total amount of B-vitamins in the supplement should be in the range of 0.20-1.4 grams/gram dry supplement as the vitamins B_6, B_9 and B_{12} usually correspond to 3-10% of the various B-vitamin complexes designed for animal and human use. Said vitamins can also be added in the form of known ingredients having relatively high concentration of said vitamins.

The most useful carboxylic acid were found to be C_{1-8} carboxcylic acids and the most prefered acids would be formic-, citric-, lactic-, propionic-, ascorbic-, fumaric- and benzoic acid. It was also found that salts of said acid advantageously could be used, especially in order to give the supplement the desired pH. Mixture of such acid and salts could be used. The new supplement should preferably be in dry powder form making the supplement free flowing. Useful desiccants would be silica MgO, CaO, etc., provided they are acceptable in feed for animals and human. The new supplement may contain antioxidants like antho-cyanin, tocopherol (vitamin E), astaxanthin and carotenoids for delaying the oxidation degradation. Optionally the new supplement may contain minerals containing K, Ca, Fe, Mg and other standard nutrients etc in cases where the standard feed are deficient in these elements.
The above new supplement were from our experiments found useful for especially horses, dogs and pigeons.. However, all other animals and humans are exposed to similar problems from being fed carboxylic acids, and can advantageously be fed this supplement. If the supplement is applied in connection with fish farming it should be mixed with the standard feed and it is then essential that said mixture can be performed without changing the composition of the supplement. Even human consumption should cause no problem and should only be beneficial.

Theoretically the various components of the new supplement could be added to the standard feed of the consumer. However, such a procedure would cause great practical problems in applying correct amounts of the various ingredients. Further, it might be difficult to obtain the observed interaction between the components.

Claims

1. Food and feed supplement containing vitamins, comprising at least one carboxylic acid and/or its salt as the basic ingredient of the supplement and the B_6, B_9 and B_{12}-vitamins in amounts of 10-50 mg/gram dry weight of the supplement, and 5-25 mg Fe/gram dry weight of supplement, 0-1 weight% desiccant, an 0-1 weight% of an antioxidant.

2. Supplement according to claim 1, characterized in that the amount of the vitamins B_{12} and B_9 at least corresponds to that which can be consumed during the metabolism of the COOH-group of the carboxylic acids.

3. Supplement according to claim 1, characterised in that it contains 0.5-3.5 weight% of iron fumarate.

4. Supplement according to claim 1, characterized in that the amounts of the vitamins B_6, B_9 and B_{12} are in the range of 10-20mg, 10-20mg and 60-250 µg/kg dry weight of the supplement, respectively.

5. Supplement according to claim 1, characterized in that the supplement contains vitamin E as antioxidant.

6. Supplement according to claim 1, characterized in that it contains an desiccant, preferably MgO.

7. Supplement according to claim 1,
characterized in that the amount of salts of the carboxylic acids results in a pH of 2.0-6 when the supplement is dissolved in water.

8. Supplement according to claim 1,
characterized in that the carboxylic acids are C_{1-8} carboxylic acids.

9. Use of supplement according to claim 1-8 in animal feed, for improving the performance of the animals, in amounts of 0.5-15 grams dry supplement/kg dry feed.

10. Use of supplement according to claim 1-8 in the feed for horses by admixing 1-25grams supplement/100kg horse weight in the standard feed for horses.

Abstract

The present invention relates to a food and feed supplement, and its use, where the supplement comprise as the basic component at least one carboxylic acid and/or its salt, an iron component and vitamins B_6, B_9 and B_{12} in amounts corresponding to at least that which theoretically can be consumed during the metabolism of the COOH-groups present and. The supplement may also contain a desiccant and an antioxidant. The supplement will have a pH in the range 2.0-6 when dissolved in water. The prefered amounts of the vitamins B_6, B_9 and B_{12} will be in the range 10-20 mg, 10-20 mg and 60–250 μm/gram dry weight of supplement, respectively. The supplement can be used in animal feed in amounts of 0.5-15 grams dry supplement/kg dry feed.

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